Amendments to the Claims:

Please amend Claim 9 to insert the word --first-- within the phrase "the timing pulse" of line 25 and to delete the word "the" from the phrase "the arrival of the timing pulse" in line 27.

Please amend Claim 10 to insert the word --second-- before the phrase "timing pulse" in line 25 and to replace the phrase "second electrical signal" with --fourth electrical signal-- in lines 25-26.

The claims as amended in this Amendment A follow below (and are in the new USPTO amendment format). Following entry of the amendments in this Amendment, the pending claims in the present application read as follows:

Claims:

1. (Original) A multiple cylinder position sensing system is provided comprising:

a first cylinder including:

a first source light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder and adapted to transmit at least a first beam of laser light at a first frequency from outside the cylinder to inside the cylinder; and

at least one first reflected light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder and configured to receive light from the first beam of laser light that is reflected off the inside of the first cylinder;

a second cylinder including:

a second source light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder and adapted to transmit at least a second beam of laser light at a first frequency from outside the cylinder to inside the cylinder; and

at least one second reflected light guide having a first end and a second end and extending from inside the cylinder to outside the cylinder and configured to receive light from the second beam of laser light that is reflected off the inside of the second cylinder.

2. (Original) The system of Claim 1, further comprising a laser light source that is optically coupled to the distal ends of both the first and second source light guides, and configured to generate a source beam of laser light, wherein the source beam is divided into the first and second beams of laser light.

3. (Original) The system of Claim 2, further comprising a first photodiode configured to receive and electrically respond to light from the first beam of laser light that is reflected off the inside of the first cylinder from the first reflected light guide.

4. (Original) The system of Claim 3, further comprising:

a laser light source driver circuit coupled to the laser light source and configured to energize the laser light source upon receipt of a trigger pulse; and

a timing circuit coupled to the laser light source driver configured to generate the trigger pulse and apply the trigger pulse to the laser light source driver circuit.

5. (Original) The system of Claim 4, wherein the laser light source is a laser diode.

6. (Original) The system of Claim 5, further comprising first and second photodiode amplifiers that are coupled to the first and second photodiodes, respectively.

7. (Original) The system of Claim 6, wherein each of the first and second photodiode amplifiers is configured to generate an output signal.

8. (Original) The system of Claim 7, further comprising a pulse expansion circuit, wherein the first and second photodiode output signals are coupled to the pulse expansion circuit.

9. (Currently amended) A method for determining the time-of-flight of laser light pulses in a plurality of hydraulic or pneumatic cylinders, the method including the steps of:

generating a first timing pulse in a timing circuit;

conducting the first timing pulse to a laser light source and responsively generating a first laser light pulse from the source;

conducting a first portion of the first laser light pulse through a first optical fiber to a first cylinder;

conducting the first portion of the first laser light pulse into the first cylinder;

reflecting the first portion off a first reflective surface coupled to a first piston in the first cylinder;

receiving the first portion of the first laser light pulse at a first photodiode and responsively generating a first electrical signal indicative of the time of arrival of the first portion of the first laser light pulse at the first photodiode;

conducting a second portion of the first laser light pulse through a second optical fiber to a second cylinder;

conducting the second portion of the first laser light pulse into the second cylinder;

reflecting the second portion of the first laser light pulse off a second reflective surface coupled to a second piston in the second cylinder;

receiving the second portion of the first laser light pulse at a second photodiode and suppressing the transmission of a second electrical signal indicative of the time of arrival of the second portion of the first laser light pulse at the second photodiode; and

providing the first electrical signal and the first timing pulse to a comparator circuit and responsively generating a first output signal indicative of a first time difference between ~~the~~ arrival of the first timing pulse and the arrival of the first electrical signal at the comparator circuit.

10. (Currently amended) The method of Claim 9, further comprising the steps of:

generating a second timing pulse in the timing circuit;

conducting the second timing pulse to the laser light source and responsively generating a second laser light pulse from the source;

conducting a first portion of the second laser light pulse through the first optical fiber to the first cylinder;

conducting the first portion of the second laser light pulse into the first cylinder;

reflecting the first portion of the second laser light pulse off the first reflective surface;

receiving the first portion of the second laser light pulse at the first photodiode and suppressing the generation of a third electrical signal indicative of the time of arrival of the first portion of the second laser light pulse at the first photodiode;

conducting a second portion of the second laser light pulse through the second optical fiber to the second cylinder;

conducting the second portion of the second laser light pulse into the second cylinder;

reflecting the second portion of the second laser light pulse off the second reflective surface;

receiving the second portion of the second laser light pulse at a second photodiode and responsively generating a fourth electrical signal indicative of the time of arrival of the second portion of the second laser light pulse at the second photodiode; and

providing the fourth electrical signal and the second timing pulse to the comparator circuit and responsively generating a second output signal indicative of a second time difference between the arrival of the second timing pulse and the ~~second~~ fourth electrical signal at the comparator circuit.

11. (Original) The method of Claim 9, wherein the step of conducting the first timing pulse to the laser light source and responsively generating a second laser light pulse from the source includes the steps of:

optically coupling the laser light source to distal ends of the first and second optical fibers; and

dividing the first laser light pulse into the first and second portions.

12. (Original) The method of Claim 11, further comprising the steps of:

providing a laser light source driver circuit;

coupling the laser light source to the driver circuit;

applying the first and second timing pulses to the laser light source driver circuit; and

energizing the laser light source responsive to the application of the first and second timing pulses to the driver circuit.

13. (Original) The method of Claim 9, further comprising the steps of:

providing a first photodiode amplifier and coupling the first photodiode amplifier to the first photodiode;

providing a second photodiode amplifier and coupling the second photodiode amplifier to the second photodiode;

generating a first gate signal in the timing circuit;

applying the first gate signal to the first photodiode amplifier to permit the transmission of the first electrical signal;

generating a second gate signal in the timing circuit; and

applying the second gate signal to the second photodiode amplifier to suppress the transmission of the second electrical signal.

14. (Original) The method of Claim 13, further comprising the step of: configuring the first and second photodiode amplifiers to generate first and second amplifier output signals, respectively.

15. (Original) The method of Claim 14, further comprising the step of:

coupling the first and second photodiode amplifier output signals; and

transmitting the coupled output signals to a pulse expansion circuit.

16. (Original) The method of Claim 14, further comprising the step of:

transmitting the first and second output signals to a pulse expansion circuit.

17. (Original) The method of Claim 16 further comprising the steps of:

generating an expanded pulse output signal in the pulse expansion circuit; and

outputting the expanded pulse output signal from the pulse expansion circuit.

18. (Original) The method of Claim 17, further comprising the steps of:

providing a pulse comparator circuit; and

inputting the expanded pulse output signal and the timing pulse into the pulse comparator circuit; and

generating a time delay output signal in the pulse comparator circuit indicative of a time delay between the timing pulse and the expanded pulse output signal.

19. (Original) A method of determining the time-of-flight of laser light in a plurality of hydraulic or pneumatic cylinders comprising the steps of:

transmitting a laser light pulse from a laser diode;

dividing the laser light pulse into at least first and second sub-pulses;

injecting the first and second sub-pulses into first and second cylinders, respectively;

reflecting the first and second sub-pulses off first and second pistons in the first and second cylinders, respectively;

receiving the first and second reflected sub-pulses to first and second photodiodes, respectively;

generating first and second electrical signals in the first and second photodiodes that are indicative of the first and second times of arrival of the first and second sub-pulses at the first and second photodiodes, respectively;

selectively coupling the first and second electrical signals in a first mode of operation to a pulse expansion circuit and a phase comparator circuit to generate a first time-of-flight signal on an output line of the phase comparator circuit that is indicative of the time-of-flight of the first sub-pulse and not of the second sub-pulse; and

repeating the foregoing steps with a second pulse of laser light but in a second mode of operation wherein the phase comparator circuit generates a second time-of-flight signal on the output line that is indicative of the time-of-flight of the second sub-pulse and not of the first sub-pulse of the second pulse of laser light.

Amendments to the Specification:

In accordance with 37 C.F.R. 121(b), please replace: old paragraph [0003] with new paragraph [0003]; old paragraph [0012] with new paragraph [0012]; old paragraph [0030] with new paragraph [0030]; old paragraph [0038] with new paragraph [0038]; old paragraph [0040] with new paragraph [0040]; and old paragraph [0046] with new paragraph [0046].

The corresponding replacement paragraphs as amended in this Amendment A follow below and are in the new USPTO amendment format to show the changes made.

Specification:

[0003] These sensors are quite ~~susceptibly~~ susceptible to damage, and suffer from being damaged during vehicle operation, or from the extremes in temperature that work and agricultural vehicles face.

[0012] In accordance with a first embodiment of the invention, a multiple cylinder position sensing system is provided that includes a first cylinder including a first source light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder and adapted to transmit at least a first beam of laser light at a first frequency from outside the cylinder to inside the cylinder, and at least one first reflected light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder ~~and adapted to transmit at least a first beam of laser~~

~~light at a first frequency from outside the cylinder to inside the cylinder, and at least one first reflected light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder~~ and configured to receive light from the first beam of laser light that is reflected off the inside of the first cylinder, and a second cylinder including a second source light guide having a first end and a distal second end and extending from inside the cylinder to outside the cylinder and adapted to transmit at least a second beam of laser light at a first frequency from outside the cylinder to inside the cylinder, and at least one second reflected light guide having a first end and a second end and extending from inside the cylinder to outside the cylinder and configured to receive light from the second beam of laser light that is reflected off the inside of the second cylinder.

[0030] An optical coupler 34 is fixed in end cap 18 to communicate laser light into chamber 32 and to communicate laser light from chamber 32 outside the cylinder. The cap itself has a threaded external surface that engages mating threads in end cap 18. These threads serve to secure the coupler to the end cap and to prevent leakage of hydraulic fluid or air out of the cylinder. The coupler also serves to hold several optical fibers 36, 38 in a fixed relationship with respect to cylinder 12. Coupler 34 is preferably disposed along the centerline of cylinder 12 such that the cylinder and the coupler share a common cylindrical axis 40. Referring now to FIGURE 2, coupler 34 supports eight optical fibers ranged in arcuate, preferably circular, pattern equidistantly spaced from the

longitudinal cylindrical axis of the coupler. These fibers gather light that is reflected off surface 26 and conduct it out of the cylinder. Fiber 36 is disposed along axis 40 and conducts light from outside the cylinder into the cylinder. Light that is conducted into the cylinder through fiber 36 is directed towards reflective surface 26 on piston 22. It reflects off piston 22 and returns in a plurality of paths to each of optical fibers ~~28~~ 38. These fibers receive the light at substantially the same time and conduct the light out of the cylinder. An optical ~~multiplexer~~ combiner 42 is optically coupled to fibers 38 and joins their/there individual light beams into a single beam that exits ~~multiplexer~~ combiner 42 in optical fiber 44. Thus, the light carried by optical coupler 44 is the combination of all the individual beams of light carried by optical fibers 38.

[0038] In addition, the longitudinal axis of each of the optical fibers 38 and optical fiber 36 are preferably parallel such that light transmitted into the cylinder through optical fiber ~~38~~ 36 will reflect off surface 26 of piston 20 and return directly to coupler 34. If surface 26 is disposed in a substantially perpendicular orientation with respect to the longitudinal axes of fibers 38 and 36, substantially all the light that is emitted into cylinder 12 by optical fiber ~~38~~ 36 will arrive back at coupler 34.

[0040] To provide this additive effect, each of optical fibers 38 is preferably the same length. Thus, when reflected light is received substantially simultaneously at each of the end of optical fibers 38 in cylinder 12, these pulses will take substantially the same time to arrive at ~~multiplexer~~ combiner 42. Since each of fibers 38 are multiplexed together,

the light in each fiber 38 will be added and inserted into optical fiber 44. Thus, any reflected light falling simultaneously on the receiving ends of fibers 38 will be combined and arrive simultaneously at the photodiode.

[0046] When laser diode 68 generates a pulse of light, that pulse is transmitted into each of the three optical fibers that are closely coupled to the laser diode. Since the three fibers are separated and connected to individual fiber optic connectors 39, the pulse of light travels down each of the three fibers through connectors 39, through each of three optical fibers 36 and into all three hydraulic actuators 10. The light pulses traverse cylinder 12, reflect off reflective surface 26 and return to optical couplers 34. Each of the individual fibers 38 for each of the couplers 34 receives a portion of the light, which is then merged at ~~multiplexers~~ combiners 42. For each of the three cylinders, the reflected pulse of laser light then travels down optical fiber 44, through collimating lens assembly 46 and falls upon photodiode 48.

Remarks:

In the present Office Action, the Examiner noted that Fig. 4 of the Applicants' application was missing from the Examiner's copy. However, the Examiner did indicate that the application is entitled to its original filing date upon the filing of a Petition under 37 C.F.R. 1.53(e). Accordingly, a Petition has been filed with Senior Petitions Attorney Christina Donnell concurrently with this Amendment A; a copy of the Petition is attached. The Petition presents evidence demonstrating that Fig. 4 was in fact deposited with the USPTO with the original application papers.

The Examiner also objected to the drawings under 37 C.F.R. 1.83(a) as failing to show every feature of the invention specified in the claims. However, upon successful acceptance of the Petition under 37 C.F.R. 1.53(e), the Examiner's copy of the application will include missing Fig. 4. At that time, the Examiner will understand that Figs. 1-4 do indeed show every feature of the invention specified in Claims 1-19. Accordingly, the Applicants respectfully request that the Examiner withdraw his objection to the drawings under 1.83(a).

The Examiner additionally objected to the disclosure of the Specification under 37 C.F.R. 1.52(a)(iv) due to the presence of handwritten typographical corrections submitted within the original specification as filed on June 4, 2001. Further, the Examiner indicated that: on page 4, lines 7-10, the phrase "and adapted to transmit at least . . . from inside the cylinder to outside the cylinder" should be deleted; on page 10, line 8, "28" should be

changed to --38--; and on page 12, line 7, "38" should be changed to --36--. Accordingly, the Applicants have provided replacement paragraphs to provide a clean version of the specification as amended in accordance with 37 C.F.R. 121(b). Because support for the amendments exists in the original specification as filed, no new matter has been added.

The Examiner rejected Claims 9-18 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter that Applicants regard as their invention. Specifically, regarding Claim 9, line 25, the Examiner indicated that the phrases "the timing pulse" and "the arrival of the timing pulse" lack proper antecedent basis. Regarding Claim 10, lines 25-26, the Examiner indicated that the phrase "the timing pulse" is unclear and that the phrase "the second electrical signal" should be changed to --the fourth electrical signal--. The Examiner noted that Claims 9-18 would be allowable if rewritten or amended to comply with 35 U.S.C. 112, second paragraph.

The Applicants have accordingly amended Claim 9, line 25 to insert the word --first-- within the phrase "the timing pulse" to provide proper antecedent basis. In addition, the Applicants have amended Claim 9, line 27 to delete the word "the" from the phrase "the arrival of the timing pulse" to also provide proper antecedent basis. The Applicants have also amended Claim 10, line 25 to include the word --second-- before the phrase "timing pulse" to provide proper antecedent basis. Finally, the Applicants have also amended Claim 10, lines 25-26, to change the phrase "second electrical signal"

to --fourth electrical signal-- to more specifically and clearly illustrate the invention. In light of the Applicants' amendments, it is believed that Claims 9 and 10 now definitely point out and distinctly claim the subject matter that the Applicants regard as their invention. Accordingly, it is also believed that Claims 11-18, which are dependent upon Claims 10 and 11, are allowable by virtue of their dependency upon allowable base Claims 10 and 11.

Finally, the Examiner noted that that Claims 1-8 and 19 are allowable because "the prior art fails to disclose or make obvious a multiple cylinder position sensing system utilizing a single laser source, a plurality of source light guides and a plurality of reflected light guides for measuring the position of plurality of cylinders."

In summary, and in light of the Applicants' amendments to the claims and specification and the filing of a Petition under 37 C.F.R. 1.53(e), it is believed that Claims 1-19 are in condition for allowance. Therefore, favorable reconsideration of the application is respectfully requested. Should the Examiner believe that the prosecution of the application could be so expedited, he is requested to call Applicants' undersigned Attorney at the number listed below.

Respectfully submitted:

BY Brant T. Maurer

Brant T. Maurer
Attorney for Applicants
Registration No. 53,285

Case, LLC
Intellectual Property Law Department
700 State Street
Racine, WI 53404
(262) 636-6357
Customer No. 26637